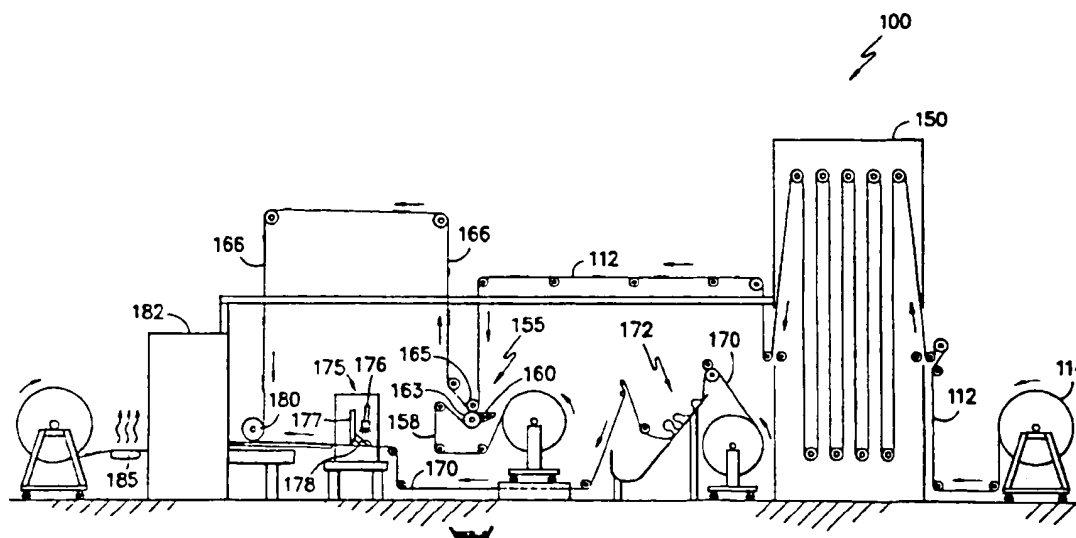




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification<sup>6</sup> : B32B 3/16, 5/18, 5/22, 7/10, 7/12, 31/00, 31/04, 31/16, 31/18, C09J 5/06, 5/08</p>	<p>A1</p>	<p>(11) International Publication Number: <b>WO 95/23691</b>  (43) International Publication Date: 8 September 1995 (08.09.95)</p>
<p>(21) International Application Number: PCT/US95/02429 (22) International Filing Date: 1 March 1995 (01.03.95)  (30) Priority Data: 08/205,834 3 March 1994 (03.03.94) US  (71) Applicant: MILLIKEN RESEARCH CORPORATION [US/US]; 920 Milliken Road, Spartanburg, SC 29303 (US). (72) Inventor: HIGGINS, Kenneth, Benjamin; 204 E. Yorktown Drive, LaGrange, GA 30240 (US). (74) Agent: ROBERTSON, James, M.; P.O. Box 1927, Spartanburg, SC 29304 (US).</p>		<p>(81) Designated States: AU, CA, CN, JP, KR, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i></p>

(54) Title: CUSHION-BACKED CARPET



## (57) Abstract

An improved cushioned carpet fabric is provided. The cushioned carpet comprises a primary carpet (112) having a plurality of pile-forming yarns (120, 134) projecting outwardly from one side. A layer of reinforcement material (158) is bonded to the side opposite the pile-forming yarns. The reinforcement layer (158) is adjacent to, and embedded in, a cushion layer (178) of a polymer such as a polyurethane. There is preferably no additional adhesive between the cushion layer (178) and the layer of reinforcement material (158) since the primary carpet fabric is mated in-situ to the polyurethane-forming composition without preheating the polyurethane-forming composition. An apparatus and process for forming the cushioned carpet fabric of the present invention are also provided.

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- 1 -

Description**CUSHION BACKED CARPET****5   Technical Field**

The present invention relates to cushion backed carpet and more particularly to carpet having a polymer backing preferably formed from a polyurethane-forming composition which is mated to a primary carpet fabric in an in-situ manner without pre-  
10   curing the polyurethane-forming composition. A process and apparatus for forming the cushion backed carpet of the present invention are also provided.

**Background Art**

Carpet and carpet tiles having cushioned backings are well known to those of skill in the art. Such cushioned backed carpet is disclosed, for example in my U.S.  
15   Patent 4,522,857 (incorporated by reference). An example of a prior art tufted carpet product is illustrated in FIG. 1A and an example of a prior art bonded carpet product is illustrated in FIG. 1B herein.

In the prior art tufted carpet, a primary carpet fabric 12 is embedded in an adhesive layer 16 in which is embedded a layer of glass scrim or nonwoven material. A  
20   foam base composite 19 is likewise adhesively bonded to the adhesive layer 16. In the prior art tufted carpet illustrated in FIG. 1A, the primary carpet fabric 12 includes a loop pile layer 20 tufted through a primary backing 22 by a conventional tufting process and held in place by a precoat backing layer of latex 24 or other appropriate adhesive including a hot melt adhesive or the like. The foam base composite 19 of the prior art  
25   tufted carpet product preferably includes an intermediate layer 26 molded to a layer of

-2-

urethane foam 28 as illustrated.

The bonded carpet product (FIG. 1B) formed according to the prior art employs the same type of foam base composite 19 adhesively bonded by adhesive laminate layers 16. However, the primary carpet fabric 12 has somewhat different components from that of the tufted product in that it preferably comprises cut pile yarns 34 implanted in a PVC, latex, or hot melt adhesive 36 having a woven or nonwoven reinforcement or substrate layer 38 of fiberglass, nylon, polypropylene or polyester.

The practice utilized in forming the product disclosed in my '857 patent and other known products involves preforming and curing the foam base composite 19 of urethane foam and backing material by practices such as are disclosed in U.S. Patents 4,171,395, 4,132,817 and 4,512,831, to Tillotson (all incorporated by reference). In the present practice, only after this foam base composite is formed and cured to some degree as a modular component, is it laminated to the carpet base.

As will be appreciated, the cost associated with such modular formation and assembly practices may be reduced by a simplified operation in which a primary carpet fabric, either with or without a stabilizing layer of scrim or the like, is laid directly into a polyurethane-forming composition and thereafter curing the polyurethane. The process can be made even more efficient if the polyurethane-forming composition requires no pre-curing prior to joining the carpet base.

Prior to the present invention, the known processes directed to the application of the polyurethane cushioned backings to fabric substrates have relied on the extremely close control of temperature in both the polyurethane composition and the adjoined fabric layer to effect stability through pre-cure of the polyurethane prior to lamination of

- 3 -

the primary carpet to form a composite structure. Such pre-cure has been largely considered necessary in order to yield a stable foam structure to which the primary carpet backing could be applied. The application of heat to the polyurethane composition prior to joinder of the heated fabric backing causes polymer cross linking  
5 which has heretofore been thought to be necessary to stabilize the foam mixture to a sufficient degree to prevent the collapse of the foam.

The present invention also provides a particularly simple composite structure amendable to in-situ formation of a stable cushion carpet composite which is not believed to have been previously utilized. Specifically, it has not been previously  
10 recognized that a single process could be used to bring all the layers of the cushioned carpet composite together by laying a primary carpet fabric, either with or without some degree of preheat, directly into a mechanically frothed polyurethane-forming composition prior to curing the polyurethane and without an intermediate layer of material.

15 As indicated, the prior art carpet forming processes typically require the separate formation of a foam base composite comprising a backing layer and a layer of urethane foam. The backing layer is then used as an intermediate layer to which a primary carpet fabric and reinforcing layer can be adhesively bonded.

In the potentially preferred practice of the present invention, the base of the  
20 primary carpet fabric is adhesively bonded to a layer of non-woven glass reinforcement material to form a preliminary composite. A puddle of polyurethane-forming composition is simultaneously deposited across a nonwoven backing material. The preliminary composite and the polyurethane-forming composition are thereafter almost

- 4 -

immediately brought together with the preliminary composite being laid into, and supported by, the polyurethane-forming puddle. The entire structure is then heated to cure the polyurethane forming composition. The preliminary composite may be slightly heated to about 120°F to improve heating efficiency although the process may likewise  
5 be carried out without such preheating.

It is to be understood that, as with the prior art products, wherein the primary carpet fabric 12 may have different embodiments, the component structure of the primary carpet fabric is not critical to the present invention. Rather it is intended that any primary carpet fabric having a pile-forming portion and a primary base may be  
10 utilized as the primary carpet fabric. By "primary base" is meant any single layer or composite structure including, inter alia, the commonly used layered composite of primary backing 22 and latex precoat 24 previously described in relation to the prior art tufted product (FIG. 1A) and the adhesive layer 36 with reinforcement substrate 38 previously described in relation to the prior art bonded product (FIG. 1B). As will be  
15 appreciated, the use of polyester in the primary base structure may be desirable due to the eventual heat curing such structure may undergo. Other embodiments as may occur to those of skill in the art may, of course, also be utilized. For example, in the bonded product, the pile forming yarns could be heat tacked to the substrate 38 as disclosed in my copending Application No. 08/091,309 to permit simplified construction of a  
20 primary carpet.

#### **Disclosure of Invention**

In view of the foregoing it is a general object of the present invention to provide

- 5 -

a carpet including a foam cushioned backing formed in-situ.

In that respect, it is an object of the present invention to provide a cushioned carpet composite wherein a reinforcement layer is disposed, at least partially, within a polymer mass which is adjacent a primary carpet with such primary carpet being laid in-  
5 situ into a puddle of the polymer without a pre-curing operation.

It is a related object of the present invention to provide a cushioned carpet composite wherein a primary carpet fabric is joined to a reinforcement layer and laid in-situ into a polyurethane-forming composition which has not undergone a pre-cure operation.

10 It is a further related object of the present invention to provide a continuous process for the in-situ formation of a cushioned carpet composite wherein a reinforcement layer is adhered to the base of a primary carpet fabric simultaneously with the application of a polyurethane-forming composition to a nonwoven backing layer and the primary carpet fabric with the adhered reinforcement layer is laid into the  
15 polyurethane-forming composition prior to curing the polyurethane-forming composition to form the carpet composite.

It is still a further related object of the present invention to provide a continuous process for the in-situ formation of a cushioned carpet composite wherein a reinforcement layer is adhered between a primary carpet base and a backing layer  
20 through the in-situ application of a polyurethane forming composition without the need for an intermediate adhesion step.

It is still a further related object of the present invention to provide an apparatus for carrying out the continuous in-situ formation of a cushioned carpet composite.

- 6 -

Accordingly, it is a feature of the present invention to provide a cushioned carpet composite including a primary carpet fabric in laminar relation to a reinforcement layer wherein such reinforcement layer is at least partially embedded in a polyurethane foam layer which is disposed adjacent to a nonwoven backing layer. The reinforcement layer may be bonded to the base of the primary carpet fabric by the polyurethane foam or by a separate adhesive.

It is a further feature of the present invention to provide a process for forming a cushioned carpet composite including the simultaneous continuous steps of adhering a woven or non-woven reinforcement material to the base of a primary carpet fabric;

10 depositing a puddle of a polyurethane-forming composition across a backing layer or support structure and laying the primary carpet fabric and adhered reinforcement material into the puddle of polyurethane-forming composition deposited on the backing layer.

It is a subsidiary feature of the present invention to provide a single step process

15 for forming a cushioned carpet composite including applying a polyurethane-forming composition adjacent a primary carpet fabric and a nonwoven backing layer with the polyurethane-forming composition at least partially holding an intermediate layer of reinforcement material.

It is yet a further feature of the present invention to provide an apparatus for use

20 in the continuous in-situ formation of a cushioned carpet composite wherein the apparatus includes a polymer application unit for depositing a polyurethane-forming composition or other suitable polymer in combination with an adhesive application apparatus for adhering a reinforcement layer to the base of a primary carpet fabric. The



- 7 -

polymer application unit and the adhesive application unit being simultaneously operable in controlled relation to one another such that the primary carpet with the adhered reinforcement layer may be laid directly into the polymer.

In accordance with one aspect of the present invention, a cushioned carpet is  
5 provided. The cushioned carpet comprises a primary carpet having a primary base and a plurality of pile-forming yarns projecting outwardly from one side. A layer of reinforcement material is bonded to the primary base on the side away from the pile-forming yarns. The reinforcement material is adjacent to, and embedded at least partially in, a cushion layer of polymer such as polyurethane. There is preferably no  
10 additional adhesive between the cushion layer and the layer of reinforcement material. An optional backing material is preferably disposed on the underside of the cushion layer. The backing material may include an adhesive backing on the side away from the cushion layer.

In accordance with another aspect of the present invention, a process for making  
15 a cushioned carpet is provided. The process involves obtaining a primary carpet fabric comprising a plurality of pile-forming yarns extending outwardly from one side of a primary base. A layer of reinforcement material is adhered to the primary carpet fabric on the side from which the pile-forming yarns do not extend, thereby forming a preliminary composite. A puddle of polymer such as a polyurethane-forming  
20 composition is applied to one side of a backing material and preferably doctored to desired thickness. The preliminary composite is then laid into the puddle of polymer without curing. Following this mating operation the polymer is preferably heat cured and the carpet is cut into tiles.

- 8 -

In accordance with still another aspect of the present invention, an apparatus for use in forming a cushioned carpet composite is provided, comprising: a reinforcement bonding unit for bonding a layer of reinforcement material to the underside of a primary carpet fabric to form a preliminary carpet composite; a polymer application unit for  
5 dispersing a polyurethane-forming composition across the surface of a carrier fabric; a mating unit for laying said preliminary carpet composite into said polyurethane-forming composition; and means for heat curing the polyurethane-forming composition subsequent to said preliminary composite being laid into said polyurethane-forming composition; wherein said reinforcement bonding unit, said polymer application and said  
10 mating unit are operable in a continuous, simultaneous manner.

### **Brief Description of the Drawings**

FIG. 1A is a cut-away view of a prior art tufted carpet with a cushioned composite structure.

15 FIG. 1B is a cut-away side view of a prior art bonded carpet incorporating a cushioned composite structure.

FIG. 2 is a schematic view illustrating a potentially preferred embodiment of the apparatus and process of the present invention.

FIG. 3A is a cut-away side view of a tufted carpet incorporating a potentially  
20 preferred structure formed by the apparatus and process of the present invention as illustrated in FIG. 2.

FIG. 3B is a cut-away side view of a bonded carpet incorporating a potentially preferred structure formed by the apparatus and process of the present invention as

illustrated in FIG. 2.

FIG. 4A is a cut-away side view of an alternative embodiment of a tufted carpet having no reinforcement layer.

FIG. 4B is a cut-away side view of an alternative embodiment of a bonded  
5 carpet having no reinforcement layer.

FIG. 5 is a schematic view illustrating an alternative apparatus and process according to the present invention for forming a cushioned carpet composite without separate adhesive bonding between the primary carpet and the reinforcement layer.

FIG. 6A is a cut-away side view of an alternative structure for a tufted carpet  
10 formed by the apparatus and process illustrated in FIG. 5.

FIG. 6B is a cut-away side view of an alternative structure for a bonded carpet formed by the apparatus and process illustrated in FIG. 5.

FIG. 7 is a schematic view illustrating yet another alternative apparatus and process according to the present invention for forming a cushioned carpet composite  
15 without separate adhesive bonding between the primary carpet and the reinforcement layer as illustrated in FIGS. 6A and 6B.

While the invention will be described and disclosed in connection with certain preferred embodiments and procedures, it is by no means intended to limit the invention to such specific embodiments and procedures. Rather it is intended to cover all such  
20 alternative embodiments, procedures, and modifications thereto as may fall within the true spirit and scope of the invention as defined and limited only by the appended claims.

#### **Best Mode For Carrying Out The Invention**

A schematic view illustrating a potentially preferred apparatus and process used

- 10 -

in forming the cushioned carpet of the present invention is illustrated in FIG. 2. The apparatus is designated generally by reference numeral 100. As illustrated, a primary carpet fabric 112 which may incorporate either a tufted or a bonded configuration as described above is drawn from a mounted carpet roll 114. As indicated previously, the  
5 primary carpet fabric 112 preferably includes a plurality of pile-forming yarns projecting outwardly from one side of a primary base. If the primary carpet 112 used in the present invention is a tufted carpet, its configuration will preferably conform to that of the primary carpet 12 illustrated in regard to the prior art in FIG. 1A, while if the primary carpet 112 used in the present invention is a bonded product, its configuration  
10 will preferably be that of the primary carpet 12 illustrated in FIG. 1B.

Alternative embodiments including those disclosed in U.S. Patent 4,576,665 to Machell (incorporated by reference) may likewise be utilized. For example, it is contemplated that specialized primary backings such as nonwoven structures comprising fiberglass sandwiched between layers of polyester may be utilized in the primary tufted  
15 carpet to impart the desired properties relating to stability thereby potentially reducing or even eliminating the need for the latex pre-coat presently utilized. Moreover, it is contemplated that if a precoat is to be utilized, it may be added directly in-line in an operation prior to any adhesive operation.

With regard to the presently preferred embodiment, in the tufted carpet of the  
20 present invention (FIG. 3A), the primary carpet fabric 112 preferably comprises a loop pile layer 120 of pile-forming yarns tufted into a primary backing 122 as is well known and held in place by a precoat of latex or a hot melt adhesive 124. It is contemplated that the latex or hot melt adhesive may be added in-line after removal from the carpet

- 11 -

roll prior to the application of any other adhesive as described below. The carpet may be steamed after addition of the precoat to facilitate subsequent printing operations if desired to reduce stresses.

In the bonded carpet of the present invention (FIG. 3B), the primary carpet  
5 fabric 112 preferably comprises a plurality of cut pile yarns 134 implanted in a latex or hot melt adhesive 136 which is laminated to a reinforcement or substrate layer 138 of a woven or nonwoven material including fiberglass, nylon, polyester or polypropylene. It is contemplated that this substrate layer 138 may be precoated with latex or other thermoplastic polymers to permit melting adhesion with the cut pile yarns 134 upon the  
10 application of heat, thereby potentially reducing or eliminating the need for the latex or hot melt adhesive 136.

The yarns 120, 134 may be either spun or filament yarns and are preferably formed from a polyamide polymer such as nylon 6 or nylon 6,6 available from DuPont Fibers in Wilmington, Delaware, although other suitable natural or synthetic yarns may  
15 likewise be employed as will be recognized by those of skill in the art. By way of example only and not limitation, other materials which might be used include polyesters such as polyethylene terephthalate (PET), and polybutylene terephthalate (PBT); polyolefins, such as polyethylene and polypropylene; rayon; and polyvinyl polymers such as polyacrylonitrile.

20 In the tufted product, the adhesive pre-coat 124 is preferably SBR latex but other suitable materials such as PVC, EVA, acrylic, and hot melt adhesives as are well known to those of skill in the art may likewise be utilized. In the event that a hot melt adhesive is utilized, it is contemplated that a reinforcement material such as a glass scrim

-12-

could be directly attached to form a composite laminate without the use of adhesives. Moreover, as previously indicated, it is contemplated that the adhesive pre-coat 124 may be entirely eliminated in the tufted product if the loop pile 120 is tufted in suitably stable relation to the primary backing 122.

5 Referring again to FIG. 2, in the potentially preferred practice the primary carpet fabric 112 is conveyed by means of a plurality of rolls through an accumulator 150 as is well known in the art to a reinforcement bonding unit 155. Simultaneously with the conveyance of the primary carpet fabric 112 to the reinforcement bonding unit 155, a sheet of reinforcement material 158 is likewise conveyed to the reinforcement bonding  
10 unit 155.

The reinforcement material 158 is preferably fiberglass nonwoven material although alternative materials may include woven glass, woven polyester, nonwoven glass, and nonwoven polyester.

At the reinforcement bonding unit 155, an adhesive 160 (FIGS. 3A, 3B) such as  
15 a hot melt adhesive is preferably applied to the reinforcement material 158 by means of a film coater or other such unit as are well known. The reinforcement material 158 and the primary carpet fabric 112 are thereafter preferably passed in mating relation between joining members such as rolls 163, 165, thereby bonding the reinforcement material 158 to the underside of the primary carpet fabric 112. That is, the reinforcement material  
20 158 is bonded on the side of the primary carpet fabric 112 from which the pile forming yarns do not project. The bonding of the reinforcement material 158 to the underside of the primary carpet fabric produces a preliminary composite 166 which is thereafter laid into a puddle of a polyurethane-forming composition as described below.

- 13 -

Although the reinforcement bonding unit 155 is illustrated in its preferred embodiment as incorporating a film coater, it is to be understood that alternative equivalent means such as application rolls, spray headers and the like may also be utilized. By way of example only, and not limitation alternative means for the  
5 application of adhesive 160 are disclosed in U. S. Patent 4,576,665 to Machell.

In the preferred practice, while the preliminary composite 166 is being formed, a backing material 170 such as a nonwoven backing is passed through a scray 172 to a polymer application unit 175 which preferably includes a polymer discharge unit 176 and a doctor blade 177. The backing material 170 is coated with a polymer 178 such as  
10 a polyurethane-forming composition as disclosed more fully below.

In the preferred embodiment, the backing material 170 is an 80% polyester, 20% polypropylene nonwoven fibrous material which is available from Spartan Mills Company in Spartanburg, South Carolina. While this represents the backing material of preference, it is to be understood that any number of alternative compositions may  
15 likewise be utilized as dictated by requirements regarding shrinkage and installation. By way of example only, in instances where very little or no shrinkage may be tolerated, the backing material may be up to 100% polyester. Further, while a nonwoven backing material may be preferred, it is contemplated that either woven or non-woven constructions may be utilized as can materials other than the polyester/polypropylene  
20 mix such as nylon, fiberglass and the like. The thickness of the backing material 170 can vary in the range of from about 0.01 inches to about 0.19 inches, although a range of between about 0.05 inches and 0.12 inches may be preferred.

As indicated, in the preferred practice the polymer application unit 175 applies a

- 14 -

deposit of a polymer 178 (FIGS. 3A, 3B) to the backing material 170 after which the height of the polymer is doctored to a desired level. In the preferred practice, the polymer applied is a polyurethane-forming composition based on a so called soft segment prepolymer of MDI (diphenylmethane diisocyanate) or an MDI derivative. The  
5 polyurethane-forming composition also preferably incorporates a silicone surfactant to improve both the frothability and stability of the polyurethane layer or "puddle" which is spread across the surface of the backing material 170.

The preferred polyurethane-forming composition for use in the present invention is disclosed in U.S. Patent 5,104,693 to Jenkins the teachings of which are  
10 incorporated herein by reference. Specifically, the preferred polyurethane-forming composition which is applied across the surface of the carrier backing 170 includes:

- (A) At least one isocyanate-reactive material having an average equivalent weight of about 1000 to about 5000;
- (B) An effective amount of blowing agent; and
- 15 (C) A polyisocyanate in an amount to provide an isocyanate index of between about 90 and about 130, wherein at least 30 percent by weight of such polyisocyanate is a soft segment prepolymer reaction product of a stoichiometric excess of diphenylmethane diisocyanate (MDI) or a derivative thereof and an isocyanate-reactive organic polymer having an  
20 equivalent weight of from about 500 to about 5,000 and wherein the prepolymer has an NCO content of about 10 to about 30 percent by weight.

The polyurethane-forming composition also preferably contains a silicone



-15-

surfactant to improve frothability and stability in the form of an organo-silicone polymer such as are disclosed generally in U.S. Patent 4,022,941 to Prokai et al. the teachings of which are incorporated herein by reference. Specifically, the preferred surfactant is preferably a linear siloxane-polyoxyalkylene (AB) block copolymer and specifically a  
5 polyalkyleneoxidemethylsiloxane copolymer. One such silicone surfactant which is particularly useful is available under the trade designation L-5614 from OSi Specialties, Inc. whose business address is believed to be 6525 Corners Parkway, Suite 311, Norcross, Georgia 30092.

A sufficient level of the silicone surfactant is used to stabilize the cells of the  
10 foaming reaction mixture until curing occurs to allow the preliminary composite 166 to be laid into the uncured polyurethane-forming composition puddle without destabilizing the layer of such polyurethane-forming composition disposed across the surface of the backing material 170. In general, the silicone surfactants are preferably used in amounts ranging from about 0.01 to about 2 parts per hundred parts by weight of component (A)  
15 and more preferably from about 0.35 parts to about 1.0 parts by weight of component (A) and most preferably from about 0.4 to 0.75 parts per hundred parts by weight of component (A).

As previously indicated, after disposition of the polymer across the backing material 170 the layer or "puddle" of polymer deposited is preferably doctored to a pre-  
20 determined height by means of a doctor blade located at the polymer application unit 175. While a simple mechanical doctor blade is preferred, alternative equivalent means such as an air knife or the like may also be used. Such an air knife is disclosed, for example, in U.S. patent 4,512,831 to Tillotson (incorporated by reference).

-16-

In an important aspect of the present invention, the primary carpet fabric 112 which is preferably joined to reinforcement material 158 to form the preliminary composite 166 can be laid directly into the polyurethane-forming composition immediately after it is doctored to the appropriate level without any need to significantly  
5 heat either the preliminary composite 166 or the polyurethane-forming composition. Accordingly, the preliminary composite 166 and the backing material 170 with the applied polyurethane-forming composition may be simultaneously delivered at room temperature to a mating roll 180 immediately following the application and doctoring of the polyurethane-forming composition. As will be appreciated, this avoidance of lag  
10 time between formation of the components of the cushioned carpet composite permits highly efficient processing readily controllable either manually or by computer control means (not shown) as are well known to those of skill in the art. In the preferred process, the preliminary composite 166 may be slightly preheated to improve operating control during lamination and curing but such preheat is not essential to formation of the  
15 desired product.

In the illustrated and preferred embodiment of the carpet, the process described above results in the layer of reinforcement material 158 being laid adjacent to and at least partially embedded in the layer of polyurethane 178. That is, the reinforcement material 158 is preferably in intimate contact with the polyurethane 178 such that the  
20 polymer material will hold the reinforcement in place.

Once the preliminary composite 166 has been laid into the polyurethane-forming composition, the resulting composite may be heated in a heating unit 182 by means of conduction, radiant, or convection heaters as are well known in the art. Contact

-17-

conduction heaters may be preferred. Such heating may be carried out at a temperature of between about 250°F and about 325°F for between about 2 minutes and 8 minutes.

The resulting foam cushion layer (FIGS. 3A, 3B) which is produced thereby preferably has a density of between about 12 pounds per cubic foot and about 20 pounds per cubic foot and more preferably between about 14 pounds per cubic foot and about 16 pounds per cubic foot.

Following the heat curing operation, the cushioned carpet composite which is formed may be passed over a unidirectional heat source 185 such as a plate heater or roll heater at about 400°F to fuse any outstanding fibers on the backing material 170 into a smooth surface. The carpet composite which is formed will thereafter preferably be cut into carpet tiles almost immediately to avoid any undesired cupping or curl.

It will be appreciated that a number of alternative practices may be incorporated into the present invention yielding slightly different products. By way of example only, the reinforcement material 158 may be left completely out of the process thereby making the use of the adhesive application apparatus 155 and adhesive 160 completely unnecessary. In such instances, the primary carpet fabric may be laid directly into the polyurethane-forming composition thereby yielding a composite structure as illustrated in Figures 4A and 4B with the polyurethane 278 immediately adjacent to the primary carpet fabric 212.

In yet another potential alternative, the backing 170, 270 may have an adhesive quick release backing attached to the face to which the polyurethane-forming composition is not applied. As will be appreciated, such a quick release backing will permit the carpet to be readily installed and removed without damaging the

- 18 -

polyurethane cushion 178, 278. Moreover, it is contemplated that in some instances the backing 170, 270 might be completely eliminated such that the polyurethane cushion 178, 278 would directly contact the flooring as disclosed in relation to my U.S. Patent No. 4,286,003 which is incorporated herein by reference.

5       An alternative process and apparatus for producing a cushioned carpet composite according to the present invention is shown schematically in FIG. 5. As illustrated, a primary carpet fabric 312 having either a tufted or a bonded configuration is drawn from a mounted carpet roll 314, through an accumulator 350, in the same manner described above. Simultaneously with the delivery of the primary carpet fabric  
10 312 to the mating roll 380, a reinforcement material 358 such as a nonwoven glass is delivered to a polymer contact roll 360 or similar device such as an extrusion coater. The polymer contact roll 360 preferably is in rolling contact with both the surface of the reinforcement material 358 as well as with an accumulation of a polymer 378 such as the polyurethane-forming composition previously described. The polymer contact roll  
15 360 serves to pick up a portion of the polymer 378 and to pass the polymer over and through the reinforcement material 358.

Simultaneously with the passage of polymer through the reinforcement material 358, a backing material 370 such as the nonwoven polyester/polypropylene described above is preferably passed in adjacent mating relation to the polymer-coated  
20 reinforcement material 358 between the polymer contact roll 360 and a backing material mating roll 379. A doctor blade 377 serves to control the depth of the polymer which does not pass through the reinforcement material 358 into contact with the backing material 370. Thus, it is to be appreciated that a polymer sandwich structure is formed

-19-

preferably comprising a layer of backing material 370, a relatively thin layer of polymer 378 such as polyurethane which has been passed through a layer of reinforcement material 358, and a doctored layer of polyurethane 378 which was not passed through the reinforcement material 358. This polymer sandwich structure can thereafter be  
5 passed to the mating roll 380 for joiner with the primary carpet fabric 312 by laying the primary carpet fabric 312 directly into the doctored layer of polyurethane 378 without any precuring operation.

A potentially preferred configuration for a resulting tufted carpet composite is illustrated in FIG. 6A. As illustrated, the reinforcement material 358 will be at least  
10 partially surrounded by, and embedded in, the polyurethane 378. As illustrated, it is contemplated that the layer of precoat may be eliminated in the tufted structure since the tufts may be held in place by the polyurethane 378. A potentially preferred configuration for a resulting bonded carpet composite is shown in FIG. 6B.

A further alternative process and apparatus for joining all layers of the cushioned  
15 carpet composite is illustrated in FIG. 7. As shown, a layer of reinforcement material 358 is preferably passed adjacent to a polymer contact roll 360 which is in simultaneous rolling contact with both the reinforcement material 358 and a deposit of polymer 378. The polymer contact roll 360 serves to spread a portion of the polymer 378 through the reinforcement material 358 to create a coating on both sides thereof. The reinforcement  
20 material 358 with its coating of polymer 378 is then joined in a laminate structure to the primary carpet fabric 312 and a layer of backing material 370 by passage through the nip between the doctor blade 377 and backing material mating roll 379. This practice will yield a bonded carpet composite structure substantially similar to those which are

- 20 -

illustrated in FIGS. 6A and 6B.

It is, of course, to be appreciated that while several potentially preferred embodiments have been shown and described, the invention is in no way to be limited thereto, since modifications may be made and other embodiments of the principles of  
5 this invention will occur to those skilled in the art to which this invention pertains. Therefore, it is contemplated by the appended claims to cover any such modifications and other embodiments as incorporate the features of this invention within the true spirit and scope thereof.

The invention may be further understood by reference to the following example  
10 which is not to be construed as unduly limiting the invention which is to be defined and construed in light of the appended claims.

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-21-

## EXAMPLE

A tufted carpet was produced by the apparatus and process as illustrated and described in relation to FIG. 2. The carpet produced has the configuration illustrated and described in relation to FIG. 3A. The production parameters were as follows:

5	Yarn	28 Ounces per square yard nylon 6,6 loop pile continuous filament.
	Primary Backing	4 Ounces per square yard nonwoven polyester.
	Precoat	14 Ounces per square yard SBR Latex filled with 100 parts $\text{CaCO}_2$ .
	Hot Melt Adhesive Laminate	30 Ounces per square yard modified polypropylene.
	Reinforcement	3 Ounces per square yard nonwoven glass with acrylic binder.
10	Urethane Foam Coverage	32 Ounces per square yard.
	Urethane Foam Density	16 Pounds per cubic foot.
	Backing Material	4 Ounces per square yard nonwoven (80% polypropylene, 20% polyester).

- 22 -

Claims

1. A carpet comprising: a primary carpet fabric having a plurality of pile-forming  
yarns projecting outwardly therefrom, and a mass of polyurethane cushioning  
5 formed from a polyurethane-forming composition, dispersed on the underside of  
said primary carpet fabric away from said plurality of pile-forming yarns, said  
primary carpet fabric being laid in-situ in to said polyurethane-forming  
composition without heat forced pre-curing of said polyurethane-forming  
composition.  
10
2. The invention as in Claim 1, wherein said mass of polyurethane cushioning has a  
cured density of between about 12 pounds per cubic foot and about 18 pounds  
per cubic foot.
- 15 3. The invention as in Claim 1, further comprising a layer of reinforcement material  
disposed at least partially within said mass of polyurethane cushioning.
4. The invention as in Claim 3, wherein said layer of reinforcement material is  
bonded to said primary carpet fabric by an adhesive.  
20
5. The invention as in Claim 3, wherein said polyurethane cushioning is the only  
adhesive between said primary carpet fabric and said layer of reinforcement  
material.



- 23 -

6. The invention as in Claim 3 wherein said layer of reinforcing material comprises a glass nonwoven material.
7. The invention as in Claim 1, further comprising a layer of backing material
8. The invention as in Claim 1, wherein said mass of polyurethane cushioning comprises polyurethane foam formed from a composition containing a soft segment prepolymer reaction product of diphenylmethane diisocyanate (MDI) and an isocyanate-reactive material having an average equivalent weight of between about 1000 to about 5000.
9. The invention as in Claim 8, wherein said mass of polyurethane cushioning comprises polyurethane foam including a silicone surfactant.
10. The invention as in Claim 9, wherein said silicone surfactant is a siloxane-polyoxyalkylene block copolymer, at a level of between about 0.01 parts and about 2.0 parts per 100 parts by weight of said isocyanate-reactive material.
11. A carpet tile, comprising:
  - a primary carpet fabric having a plurality of pile-forming yarns projecting outwardly therefrom;
  - a layer of reinforcement material bonded to the underside of said primary carpet fabric;

-24-

a cushion layer of polyurethane foam at least partially surrounding said layer of reinforcement material with no additional adhesive between said cushion layer and said layer of reinforcement material; and

a layer of backing material disposed on the underside of said cushion layer.

12. The invention as in Claim 11, wherein said polyurethane foam is a diphenylmethane diisocyanate (MDI) soft segment prepolymer polyurethane including a silicone surfactant.

13. The invention as in Claim 12, wherein said silicone surfactant is a polyalkyleneoxidemethylsiloxane copolymer.

14. A process for in-situ formation of a cushion backed carpet composite, comprising the steps of:
- (a) applying a polyurethane-forming composition to a support surface; and
  - (b) laying a primary carpet fabric into the polyurethane-forming composition prior to curing the polyurethane-forming composition.

15. The process as in Claim 14, wherein the polyurethane-forming composition includes a polyisocyanate comprising a soft segment prepolymer of MDI.

16. The process as in Claim 15, wherein the polyurethane-forming composition

-25-

- includes a silicone surfactant.

17. The process as in Claim 16, wherein the silicone surfactant comprises a siloxane-polyoxyalkylene block copolymer.

5

18. A process for making a cushioned carpet composite, comprising the steps of:
- (a) adhesively bonding a layer of reinforcement material to the base of a primary carpet fabric to form a preliminary carpet composite.
  - (b) applying a puddle of polyurethane-forming composition to one side of a support structural; and
  - (c) laying the preliminary carpet composite formed in step (a) into the puddle of polyurethane-forming composition.

10

19. The process as in Claim 18, comprising the further subsequent step of:

- 15 (d) heat curing the polyurethane forming composition.

20. The process as in Claim 19 comprising the further subsequent step of:

- (e) cutting the cushion composite formed in step (d) into carpet tiles.

- 20 21. The process as in Claim 18 wherein the primary carpet fabric is a bonded carpet fabric.

22. The process, as in Claim 18 wherein the primary carpet fabric is a tufted carpet

-26-

- fabric.

23. The process as in Claim 18, wherein in step (a) the layer of reinforcement material is bonded to the primary carpet fabric by means of a hot melt adhesive.
- 5
24. The process as in Claim 18, wherein in step (a) the reinforcement material is bonded to the primary carpet fabric means of a latex adhesive.
25. The process as in Claim 18, wherein the polyurethane-forming composition applied in step (b) yields a foam having a final density of between about 12 pounds per cubic foot and about 18 pounds per cubic foot.
- 10
26. The process as in Claim 18, wherein the polyurethane-forming composition applied to the backing material in step (b) includes a silicone surfactant.
- 15
27. The process as in Claim 26, wherein the silicone surfactant comprises a siloxane-polyoxyalkylene block copolymer.
28. The process as in Claim 18, wherein the polyurethane-forming composition includes at least one isocyanate-reactive material and a polyisocyanate including a soft segment prepolymer of MDI.
- 20
29. A carpet formed by the process of Claim 28.

- 27 -

30. A process for making a cushion backed carpet, comprising the steps of:
- (a) applying a polymer coating over a layer of reinforcement material to form a coated sandwich structure having in cross section, first polymer layer a second polymer layer, and a layer of reinforcement material between said first and second polymer layers; and
  - (b) joining a primary carpet fabric to one of said first or second polymer layers through adhesion between said polymer layer and said primary carpet fabric.

- 10 31. The process is as in Claim 30, including the additional step of:
- (c) joining a layer of backing material to the other of said first or second polymer layers.

- 15 32. The process as in claim 31, wherein steps (b) and (c) are performed simultaneously.

33. The process as in claim 31, wherein said polymer coating is applied over said layer of reinforcement material by means of an application roll.

- 20 34. The process as in claim 31, wherein said polymer coating applied in step (a) comprises a polyurethane-forming composition in its uncured state.

35. The process as in claim 34, wherein said polyurethane-forming composition

- 28 -

applied in step (a) includes at least one isocyanate-reactive material and a polyisocyanate comprising a soft segment prepolymer of MDI.

5 36. The process as in claim 35, wherein said polyurethane-forming composition applied in step (a) further includes a silicone surfactant.

37. The process as in claim 31, comprising the further subsequent step of:

(d) heat curing the polymer coating applied in step (a).

10 38. An apparatus for the in-situ formation of a cushion backed carpet, the apparatus comprising: a reinforcement bonding unit for bonding a layer of reinforcement material to the underside of a primary carpet fabric to form a preliminary carpet composite; a polymer application unit for dispersing a polyurethane-forming composition across a support surface; a mating unit for laying said preliminary  
15 carpet composite into said polyurethane-forming composition; and means for heat curing the polyurethane-forming composition subsequent to said preliminary carpet composite being laid into said polyurethane-forming composition, wherein said reinforcement bonding unit, said polymer application unit and said mating unit are operable in a continuous, simultaneous manner.

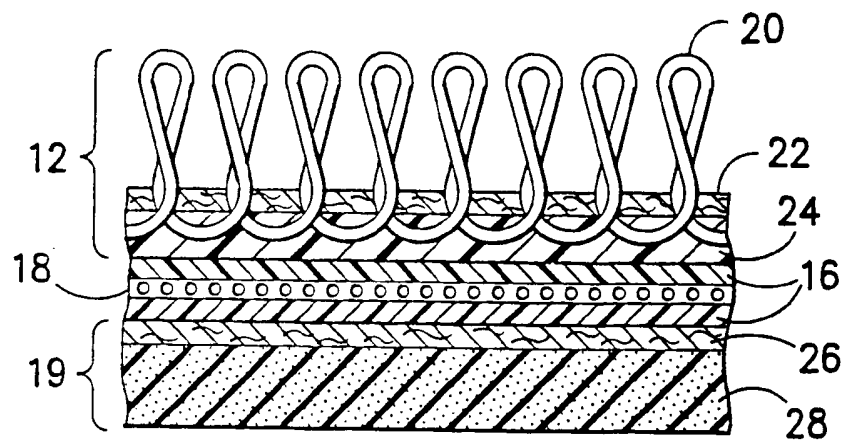
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39. An apparatus for the in-situ formation of a cushion backed carpet without the use of adhesive other than the cushion forming material, the apparatus comprising: a polymer application unit for applying a polymer coating at least

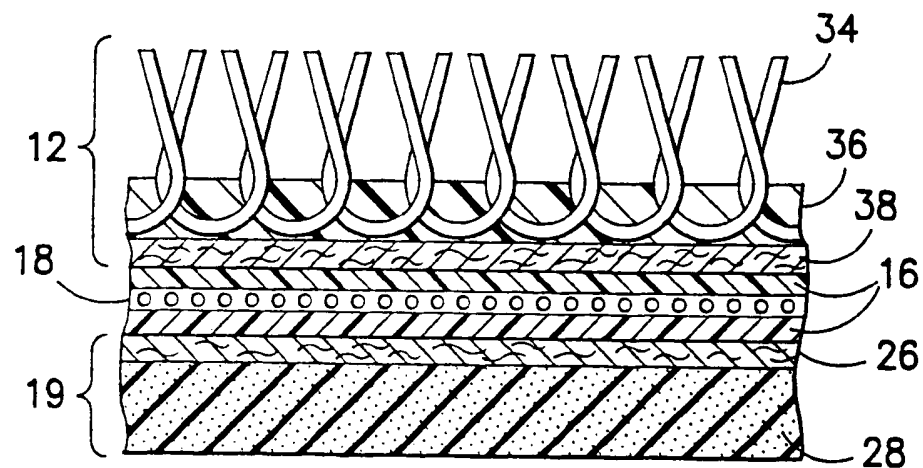
-29-

- partially through a layer of reinforcement material to generate a coated substrate; a mating assembly for mating a primary carpet fabric to one surface of said coated substrate; and means for heat curing the polymer coating subsequent to mating the primary carpet to the coated substrate to adhesively bond the coated substrate to the primary carpet.
- 5
40. The apparatus as in Claim 37, further comprising a mating assembly for mating a backing material to one surface of said coated substrate.

1/6



*FIG. -1A-*  
PRIOR ART



*FIG. -1B-*  
PRIOR ART



2/6

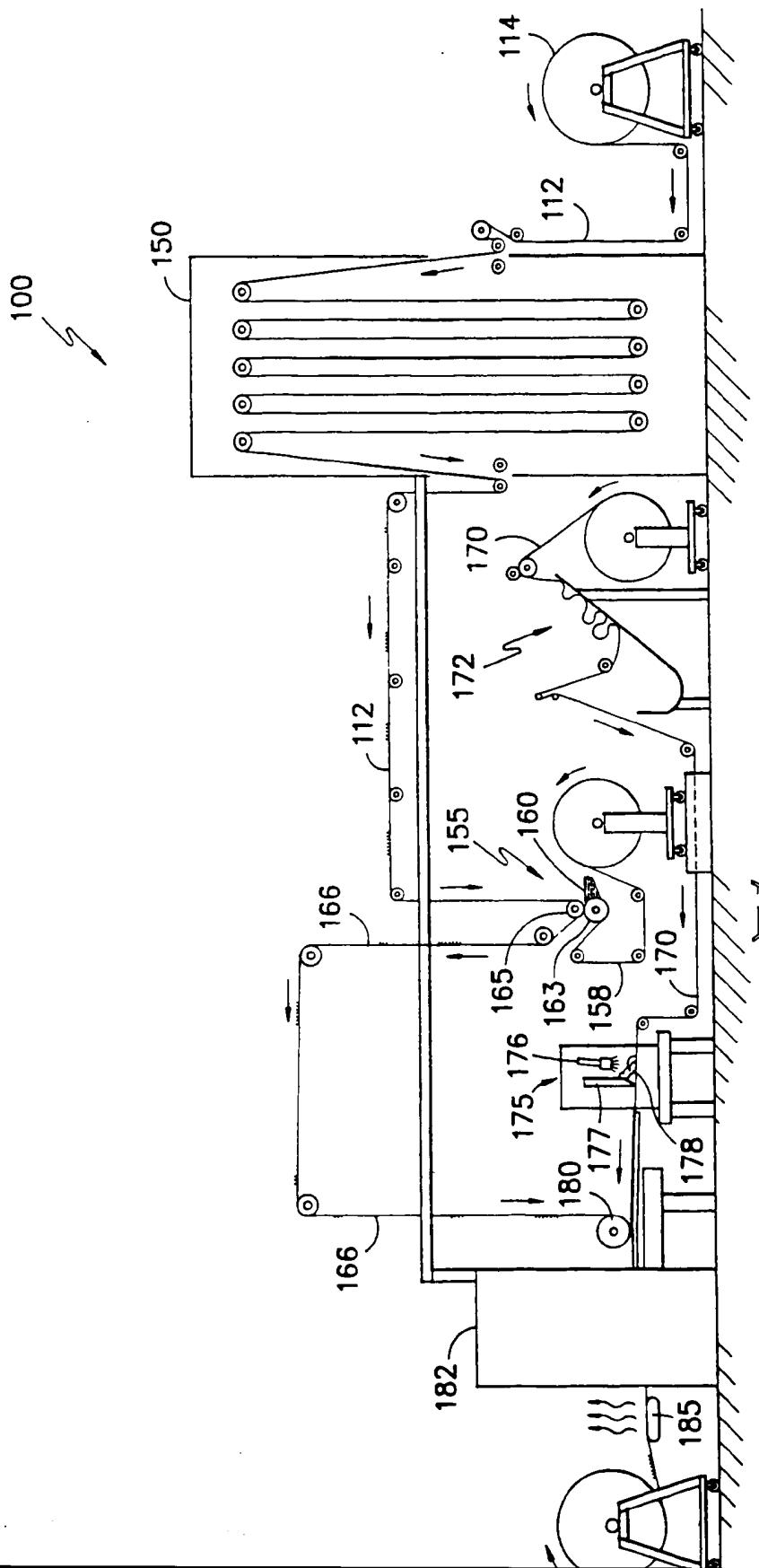


FIG. -2-

3/6

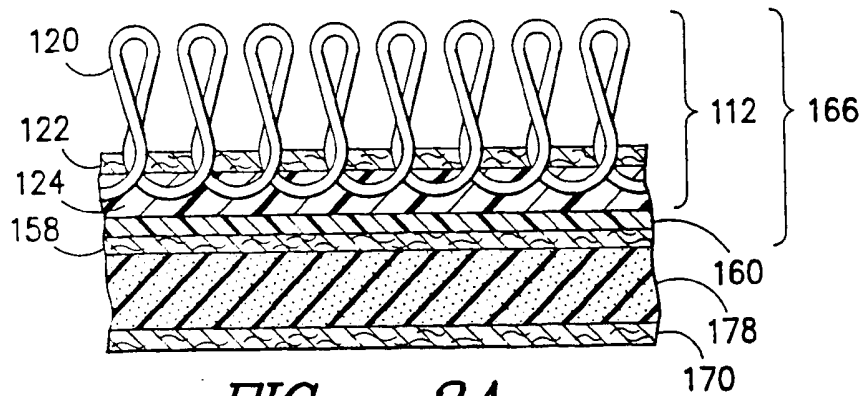


FIG. -3A-

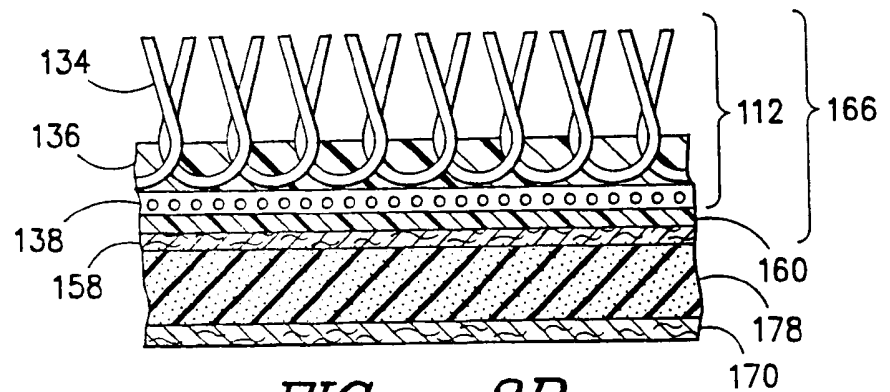


FIG. -3B-

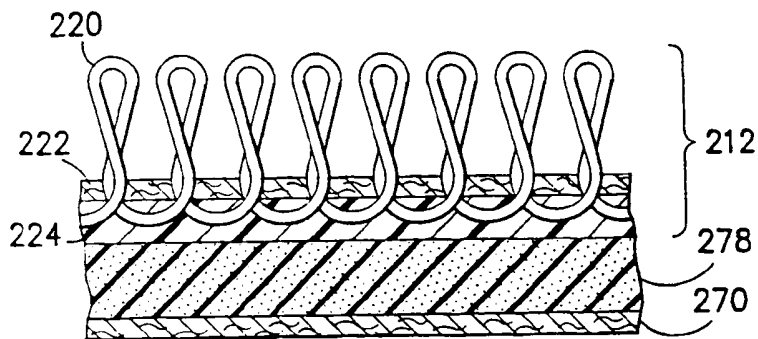
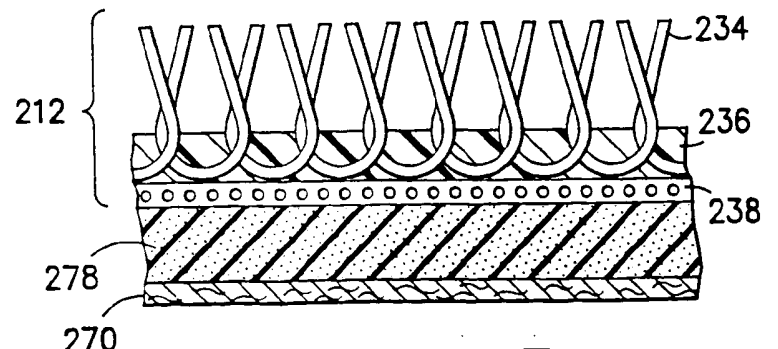


FIG. -4A-



4/6

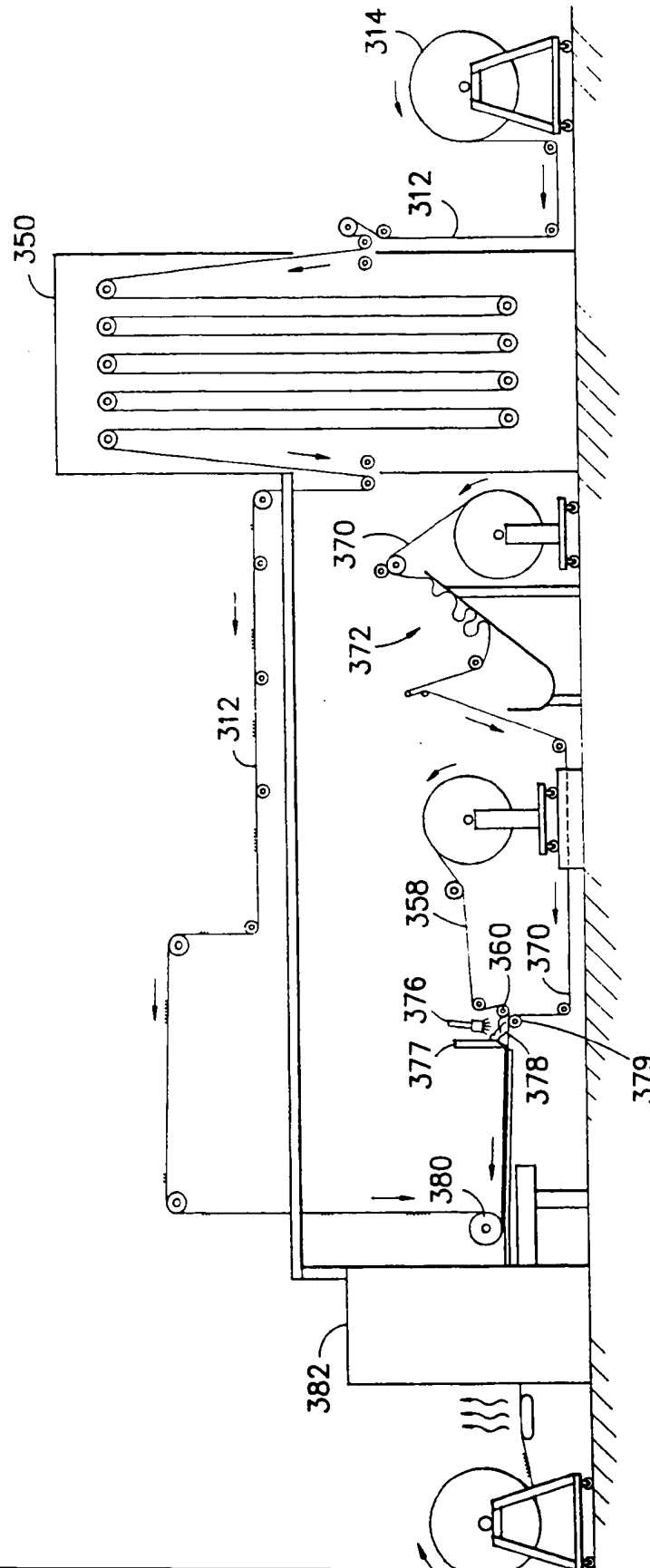
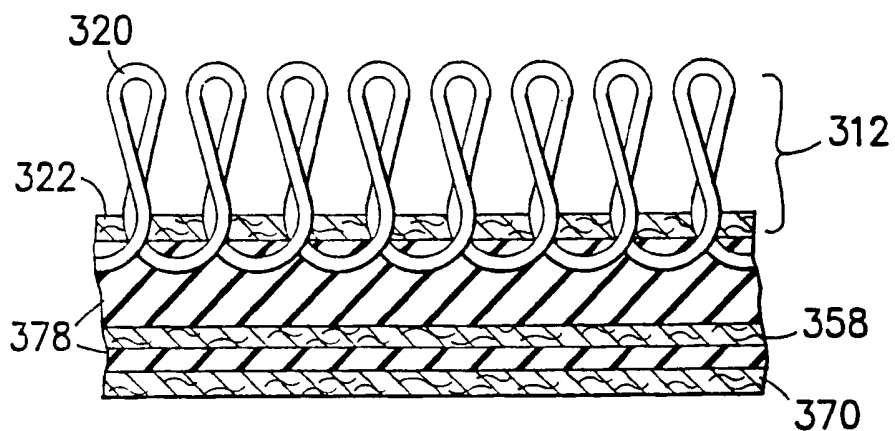
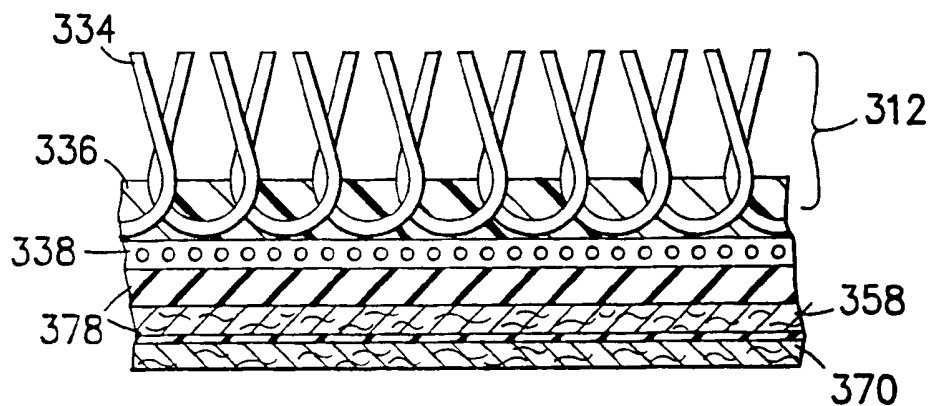


FIG. -5-

5/6

*FIG. -6A-**FIG. -6B-*

6/6

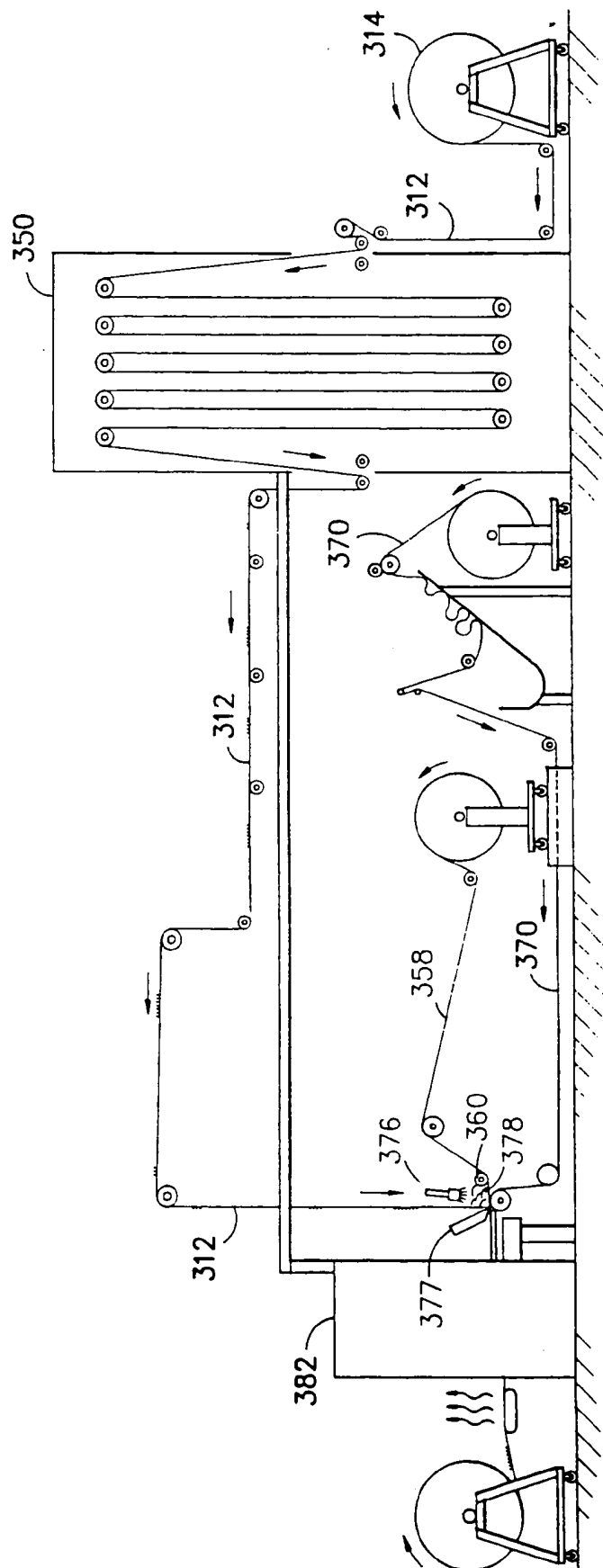


FIG. -7-

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US95/02429

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : Please See Extra Sheet.

US CL : Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US, A, 4,171,395 (TILLOTSON) 16 October 1979, col. 2, lines 64 - 68 & col. 3, lines 15 - 31.	1, 14 ----- 2, 8, 9, 10, 15-29, 38
X --- Y	US, A, 3,123,508 (WAUGH) 03 March 1964, col. 2, lines 6-17, 41-43 & 60-70.	1, 14, 39, 40 ----- 2, 8, 9, 10, 15-17, 32, 39-40



Further documents are listed in the continuation of Box C.



See patent family annex.

Special categories of cited documents:	
*A* document defining the general state of the art which is not considered to be part of particular relevance	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*E* earlier document published on or after the international filing date	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*O* document referring to an oral disclosure, use, exhibition or other means	
*I* document published prior to the international filing date but later than the priority date claimed	*G* document member of the same patent family

Date of the actual completion of the international search

29 MARCH 1995

Date of mailing of the international search report

12 APR 1995

Name and mailing address of the ISA/US

Commissioner of Patents and Trademarks

Authorized officer:

P. M. T. TRANH

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US95/02429

## A. CLASSIFICATION OF SUBJECT MATTER:

IPC (6):

B32B 3/16, 5/18, 5/22, 7/10, 7/12, 31/00, 31/04, 31/16, 31/18, C09J 5/06, 5/08

## A. CLASSIFICATION OF SUBJECT MATTER:

US CL :

156/78, 182, 269, 307.3, 310, 331.7, 543, 547, 549, 578; 428/95, 96, 97, 301, 302

## B. FIELDS SEARCHED

Minimum documentation searched

Classification System: U.S.

156/72, 77, 78, 90, 182, 250, 269, 270, 307.3, 310, 331.7, 543, 547, 549, 578; 428/86, 94, 95, 96, 97, 295, 301, 302, 422.8, 542.6

## INTERNATIONAL SEARCH REPORT

 International application No.  
 PCT/US95/02429

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	EP, A, 268,875 (THE DOW CHEMICAL COMPANY) 01 June 1988, page 4, col. 2, lines 53-56, page 5, col. 1, lines 1-28.	1, 3, 5, 7, 30, 31, 34, 37 ----- 2, 4, 6, 8 - 13, 32, 33, 35, 36, 38
X ---- Y	US, A, 3,926,700 (HOPKINS, JR. ET AL) 16 December 1975, (Figure 3, col. 4, lines 10-11, col. 6, lines 28-35, col. 8, lines 31-32.	1, 2, 14 ----- 8-10, 12, 13, 14, 25, 33
X ---- Y	US, A, 3,664,863 (DIJKHUIZEN ET AL) 23 May 1972, col. 1, lines 4-11.	1 ----- 21
Y	US, A, 5,104,693 (JENKINES) 14 April 1992, see the abstract.	8-10, 12, 13, 15- 17, 26-29, 35, 36
Y	US, A, 4,022,941 (PROKAI ET AL) 10 MAY 1977, col. 2, lines 50-52.	8-10, 12, 13, 16, 17, 26, 27, 36
Y	US, A, 3,238,595 (SCHWARTZ ET AL) 08 March 1966, col. 2, lines 64-68 & col. 3, lines 15-31.	18, 19, 20-29
Y	US, A, 4,689,256 (SLOSBERG ET AL) 25 August 1987, figure 2.	20
Y	US, A, 3,537,946 (TRUAX ET AL) 03 November 1970, col. 3, lines 54-61.	30-33, 37
Y	US, A, 4,661,380 (TILLOTSON) 28 April 1987, col. 1, lines 35-54, 61-65 & col. 3, line 67 to col. 4, line 2.	33
Y	US, A, 5,030,497 (CLAESSEN) 09 July 1991, col. 2, lines 31-33.	6